Reversible Chemochromic Hydrogen Detectors

Hazardous-Leak Detection and Isolation

The Florida Solar Energy Center (FSEC), affiliated with the University of Central Florida, has invented a reversible pigment that changes from light beige to blue when exposed to hydrogen and back to light beige when exposed to atmospheric oxygen. In laboratory and environmental studies, the FSEC pigment in its tape form failed to change color adequately when exposed to hydrogen after one day of exposure at Kennedy Space Center's Beach Corrosion Test Facility. The reversible hydrogen-detecting tape also lost its ability to change color after being placed in an environmental chamber at 45 °C for one day. The first attempts at extruding the reversible pigment into various polymers were unsuccessful because of the pigment's poor thermal stability. The goal of this project was to formulate a pigment with improved thermal and environmental stability for extrusion into a variety of appropriate polymer matrices.

The formulation of the reversible hydrogen-detecting pigment was modified by removing one reagent and chemically modifying the hydrogen sensitive ingredient. This was intended to improve the hydrophobicity of the pigment and alter the thermal degradation mechanism. A sensor with the new pigment was placed in an oven at 45 °C for 3 days. The figure shows how the newly formulated pigment changed color (ΔE) as it was exposed to 100 percent hydrogen. A larger ΔE indicates a greater color difference. The maximum ΔE for the modified sensor decreases by less than 2 following heat treatment when compared to an unheated sample. With a similar heat treatment, the original reversible pigment lost its sensitivity to hydrogen, since the maximum ΔE attained is less than 3. After changing color when heated to 45°C, the modified pigment was extruded at high temperatures into a tape. The extruded tape retained its color-changing ability.

Preliminary results show that the hydrophobicity of the FSEC pigment increases after the pigment has been modified; however, further testing is required to validate long-term results in a relevant environment.

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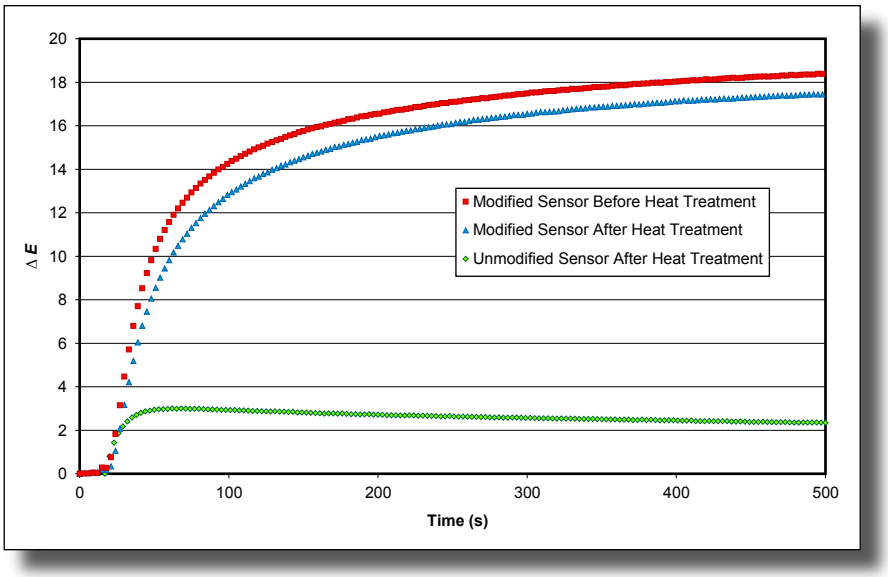

Comparison of the detection performance sensors in 100 percent hydrogen.